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CALIFORNIA UNIV IRVINE DEPT OF ELECTRICAL ENGINEERING  
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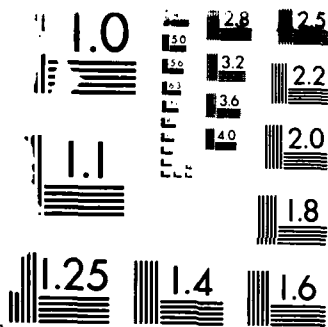
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) An Ion-Milling Machine has been purchased under the sponsorship of the DOD- University Research Instrumentation Program. A special laboratory compartment together with necessary electrical and wet-lab utilities were constructed for installation of the complete ion milling machine facility. The facility will be in full operation in the near future and is expected to provide vital utility to this principal investigator's on-going and future DOD-sponsored research projects as well as other user groups inside and outside the campus.		

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**AFOSR-TR- 86-2089**

DOD-UNIVERSITY RESEARCH INSTRUMENTATION PROGRAM

*FINAL*  
SCIENTIFIC REPORT

for

Air Force Office Of Scientific Research

Grant No. AFOSR 84-0270

For the Period

1 July 1984 - 30 April 1986

Prepared By

Chen S. Tsai, Principal Investigator  
Professor of Electrical Engineering  
University of California  
Irvine, California 92717

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## DOD-UNIVERSITY RESEARCH INSTRUMENTATION PROGRAM

SCIENTIFIC REPORT

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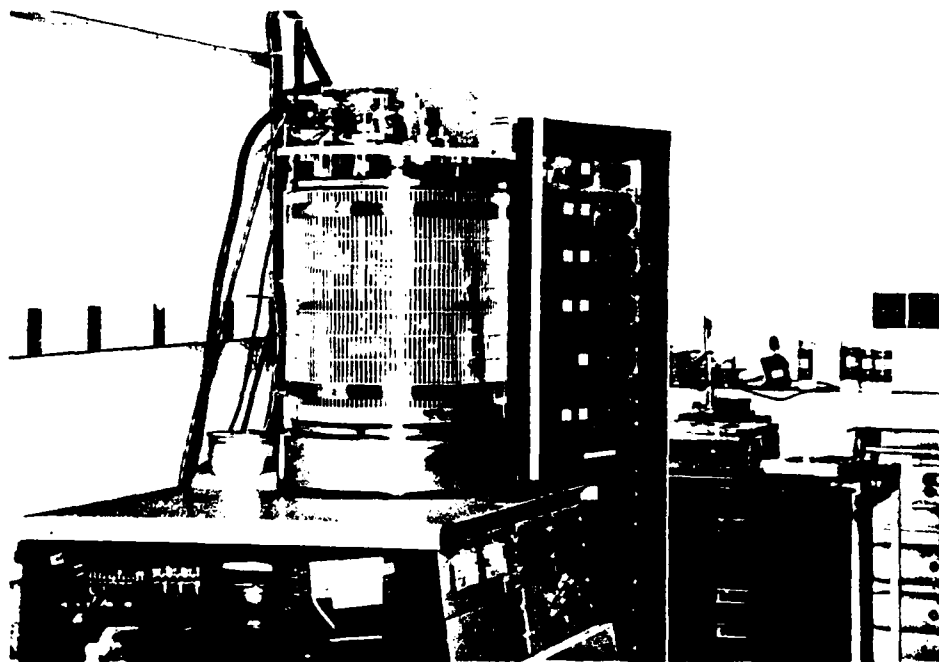
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## I. INTRODUCTION AND OBJECTIVE

This principal investigator's group at UC Irvine have been conducting a number of DOD-sponsored research projects on Integrated Optics for some time. These research projects concern conception, experimentation, and realization of new and novel guided-wave optic devices and modules with applications to wideband multichannel integrated/fiber optic communications, radar signal processing, and computing systems. For this purpose, sophisticated instrumentation is required for fabrication of test devices with complex geometry and micron or submicron dimensions. This principal investigator has established a microfabrication facility from scratch since joining UCI six years ago. However, the capability of this facility is at present rather limited in terms of line resolution, contact uniformity, fabrication yield, and versatility. Although much encouraging results have been demonstrated with the preliminary devices, the lack of an ion-milling machine has kept on-going research projects from achieving much more results expeditiously. Similarly, the lack of the Ion Milling Machine has kept his group from fabricating micron-width "grooves," "slots," "gratings," "ridge waveguide," etc., on  $\text{LiNbO}_3$  and GaAs substrates for robust coupling between the optical fibers and the devices being explored, and thus realization of integrated optic device modules.

The requirement for this particular instrumentation will become even more critical in Professor Tsai's forthcoming research on various new devices and modules that fall into DOD's areas of interest. The objective of this DOD-University Research Instrumentation Grant<sup>(1)</sup> was to provide \$84,000 through the AFOSR for purchase of such an ion milling machine. As a matching fund the University of California at Irvine provided \$35,850 for purchase of required accessory components and thus establishment of a complete and working

facility. A delay in construction of the laboratory compartment was incurred due to lack of suitable laboratory space. However, a laboratory compartment plus required electrical and wet-lab utilities were constructed during the past summer and the facility has been installed for operation. The attached is a photograph of the facility that has been installed in Room 426 of the Engineering Building.



## II. PROGRESS DURING PROGRAM YEAR

### A. AFOSR Funds And UCI Matching Funds

AFOSR Funds:	\$84,000
UCI Matching Funds:	
1. Equipment purchase	35,850
2. Laboratory Construction And Equipment Installation	<u>17,000</u>
Total:	\$136,850

### B. List of Equipment Purchased

#### i. Basic Ion Milling Machine

Vendor: Ion Tech  
 2330 E. Prospect, Fort Collins, CO 80525  
 (303) 221-1807

1. Model 11-1500-250, Ion Beam Source	\$14,833
2. Model 11-1500-250EL, Electronics System	12,525
3. Model 11-1500-250, Interface Kit	2,205
4. Model 6-MF-500, 6" Etch table	8,285
5. Model SE-600-RAP, 6" pumping system	31,315
6. 18" x 21" pyrex cylinder, Guard and Boot	1,470
7. Model 5-DF-300, Triple Target Holder	5,435
8. Model 3-SH-100, Single Substrate Holder	<u>7,270</u>
Subtotal:	\$83,340
Tax:	<u>5,000.40</u>
Total:	\$88,340.40

#### Funding Sources:

AFOSR:	\$84,000
UCI:	\$ 4,340.40

#### ii. Surface Profiler

Vendor: Tencor Instruments  
 2400 Charleston Road, Mountain View, CA 94043  
 (415) 969-6767

Model 110-02000 Alpha Step 200	
Computerized Surface Profiler	\$24,300
	Tax
	<u>1,458</u>
	Total
	\$25,758

Funding Source: UCI



iii. Vacuum Pump

Vendor: Leybold-Heraeus  
 1775 E. Lincoln Ave., #105, Anaheim, CA 92805  
 (714) 772-0382

Model D16AC, vacuum pump, with adaptors	\$ 1,671
Tax	100.26
Total	<u>\$ 1,771.26</u>

Funding Source: UCI

iv. Electronic Balance

Vendor: Fisher Scientific  
 755 State Highway Rt. 202, Somerville, NJ 08876

Model Brankman 1712MP8	\$ 2,100.45
Tax	126.03
Total	<u>\$ 2,226.48</u>

Funding Source: UCI

C. LABORATORY CONSTRUCTION AND EQUIPMENT INSTALLATION

A special laboratory compartment together with necessary electrical and wet-lab utilities was constructed most recently for installation of the complete ion milling machine facility on the fourth floor of the Engineering Building. The total cost (\$17,000) for this construction was provided by the university funds. The components are being assembled and tested, and the facility will be in full operation in the near future.

### III. IMPACTS OF EQUIPMENT

#### A. User Groups

A great majority of this principal investigator's research group which consists of approximately ten Ph.D. students will be involved in the operation and maintenance of this new facility. Other faculty users include Drs. C. C. Lee and G. Sonek of the Electrical Engineering Department and Drs. D. Mills, A. Maradudin, and R. Wallis of the Physics Department and Drs. Peter Renzepis and John Hemminger of the Chemistry Department. The faculty from the Departments of Physics and Chemistry are pursuing research on Physics and Chemistry of Surfaces and Interfaces in metals and semiconductors. Some of the research such as Laser Light Scattering from Surface Electromagnetic Waves and picosecond spectroscopy are closely related to Integrated Optics. The instrumentation requested is also required in the experimental phase of that research.

In addition, this new facility will be made available to the various industrial groups in the surrounding areas who are pursuing DOD-sponsored research on Integrated Optic Signal Processing/Computing, Infrared Electrooptic Materials/Devices, and Fiber Optic Sensors.

#### B. Impacts On On-Going And New Research

One of the ultimate objectives of our on-going and future DOD-sponsored research programs is to develop efficient and robust coupling or interfacing mechanism between optical fibers and the various guided-wave acoustooptic, electrooptic, and magneto optic devices so that related integrated/fiber optic modules can be realized. Consequently, the ion milling machine will enable us to fabricate grooves and slots in both  $\text{LiNbO}_3$  and GaAs substrates and thus employ the various techniques (such as the flip-chip method devised by researchers at NRL) to realize the integrated optic modules

intended as well as new device modules to be explored through DOD sponsorship. In addition, the machine will be used to fabricate and tailor channel waveguides and other micro-structures for both active and passive components that are being explored at the principal investigator's laboratory.

#### IV. REFERENCE

1. Proposal to 1984-85 DOD-University Research Instrumentation Program

Principal Investigator: Chen S. Tsai

UCI Proposal #8018, Submitted on Dec. 13, 1983.

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